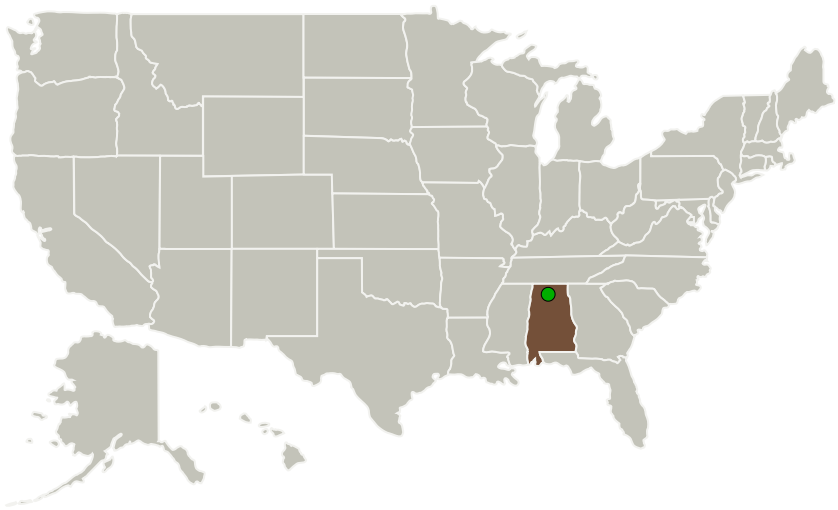
Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development, Phase II

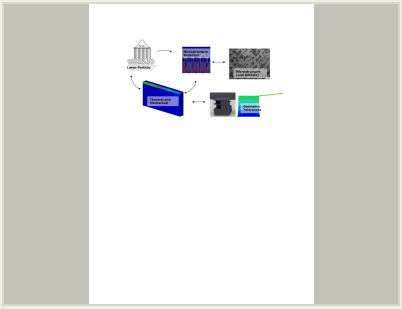
Completed Technology Project (2015 - 2017)

Project Introduction

Despite the rapid commercialization of additive manufacturing technology such as selective laser melting, SLM, there are gaps in process modeling and material property prediction that contribute to slow and costly process development, process qualification and product certification. To address these gaps, CFDRC and our partner Dr. Kevin Chou, University of Alabama, will develop multiple computationally efficient, high-fidelity simulation tools for the SLM process. During Phase I the team demonstrated efficient thermomechanical simulations for centimeter size test coupon builds, the feasibility of applying multiphase flow models to analyze particle scale effects on material variations, application of phase field models to predict microstructure evolution, and experimental characterization for model verification and refinement. During Phase II, the modeling tools will be extended to improve computational efficiency and scalability to aerospace component dimensions by further leveraging parallel computing and other acceleration techniques. The fidelity of the models will be enhanced to better predict distortion, residual stress, microstructure and defects from process conditions; and additional process data will be used to validate the resulting codes. The high-fidelity, physics based nature of the codes will allow straightforward application to new materials, and to guiding development of and verifying analytical physics models for process control.

Primary U.S. Work Locations and Key Partners





Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development Project Image

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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
The University of Alabama	Supporting Organization	Academia	Tuscaloosa, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

May 2015: Project Start

May 2017: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140640)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

J. Vernon V Cole

Co-Investigator:

J F Cole

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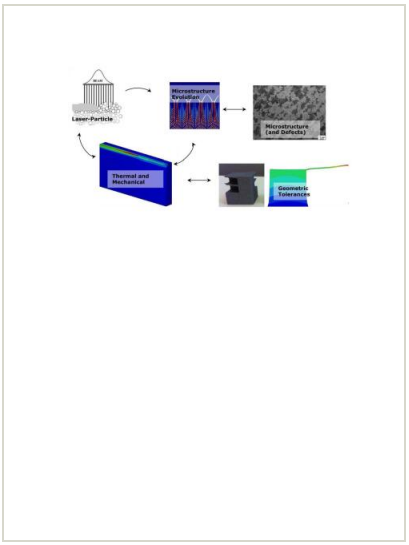
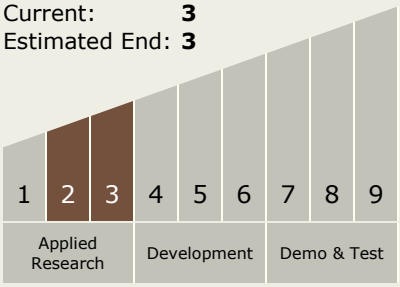
Images



Project Image
Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development Project Image
(https://techport.nasa.gov/image/136813)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System